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'I Prefer 30°?': Business strategies for influencing consumer laundry practices to reduce carbon emissions

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Abstract

This paper analyses businesses' initiatives to influence consumption carbon emissions in home laundering, principally by persuading consumers to wash clothes at lower temperatures. A number of voluntary business initiatives have sought to change consumer practices, coming from detergent manufacturers, their industry association and retailers. This paper analyses their impact at system level, by assessing the coevolutionary interactions between 'Supply', from consumer-facing firms, whose principle business is to sell products to consumers, both manufacturing and retailing, and 'Demand' from consumers, whose interactions with the businesses arise from shopping, using and receiving consumer messages from the firms. The research analyses the interactions between the business case drivers for presentation of consumer messages to reduce laundry emissions and the drivers of changes in consumer laundry practices. This enables inductive inference of the causal relationships over time between businesses' strategies to communicate with consumers and changes in users' laundry temperatures.

The paper concludes that, in spite of considerable efforts and resources, these business initiatives have not resulted in the intended level of change in consumer practice that would deliver significant emissions reductions. Consumption emissions from households are a result of interdependent systems of provision, technologies and infrastructure, so stronger actions by business to influence consumer practices as well as further regulatory drivers are likely to be needed to deliver stricter emission reduction targets. This research contributes to the field of sustainable consumption through bringing together a coevolutionary framework with theories of business model innovation and social practices, in order to analyse whole systems of competing businesses' strategies in context with technologies, institutions and ecosystems.

‘I Prefer 30°’?: Business strategies for influencing consumer laundry practices to reduce carbon emissions

1. Introduction

A series of voluntary business initiatives have been undertaken in Western Europe since 1996 to persuade consumers to wash clothes in cooler water, from leading detergent manufacturers, such as Procter and Gamble (Mylan, 2017), Unilever (Kingsbury et al., 2012), their industry association (A.I.S.E., 2013a) and retailers, such as Marks and Spencer (Morgan, 2015). These would contribute to reducing carbon emissions, as well as saving money for consumers, but these initiatives have had limited success. This paper analyses their impact, by assessing the coevolutionary interactions between ‘Supply’ and ‘Demand’ systems (Murmman, 2013). ‘Supply’ is from consumer-facing firms, whose principle business is to sell products to consumers, both manufacturing and retailing. ‘Demand’ arises from consumers, whose interactions with the businesses arise from shopping, using and receiving consumer messages from the firms. The research analyses the factors that have led to the presentation of consumer messages to reduce laundry emissions, using a business model innovation lens (Schaltegger et al., 2012) and the drivers of changes in consumer laundry behaviours, from a social practice perspective (Spaargaren, 2011). This enables inductive inference of the causal relationships over time between businesses’ strategies to communicate with consumers and changes in users’ laundry temperatures.

Domestic laundering (and other consumption activities) needs to become substantially less carbon intensive, in order to contribute towards meeting EU policy targets to reduce greenhouse gas emissions by 20% by 2020 and by 80% by 2050 (both from a 1990 base) (European Commission, 2017), consistent with the 2015 international Paris Agreement on mitigating climate change. Laundering is important because both washing machines and tumble dryers were amongst the top sixteen appliances consuming the most energy in UK households (Haines et al., 2010), accounting for 10.7% on average of electricity use in UK households (Palmer and Terry, 2014), in what was the most detailed monitoring of domestic electricity use ever carried out in the UK (Owen, 2012). In a carbon footprint analysis of all garments in use in the UK in 2009, washing clothes produced the third biggest emissions, after fabric production and yarn production (WRAP, 2012), and approximately two thirds of energy expended in the use stage of the clothing life cycle is due to washing (Madsen et al., 2007). The biggest opportunities to reduce the emissions from clothes washing arise from convincing consumers to wash clothing less frequently and with less intensity, identified, for example, by Allwood et al. (2008) for the UK and Ellmer et al. (2017) for Germany and this includes washing at lower temperatures (WRAP, 2012). One study showed that an average automatic machine washing temperature reduction of 6-7°C is equivalent to a 21% reduction in average energy use (Pakula and Stamminger, 2015). There are both behavioural and technical aspects to accessing these opportunities; for instance, clothing can be

washed less often, and designed so that it needs less washing (Laitala and Boks, 2012) and clothing can be washed at lower temperatures, with clothing, washing machines and detergents designed so that lower temperature washing is effective (Bain et al., 2009).

Detergent manufacturing is a competitive global industry, dominated by three large international companies, Procter & Gamble (P&G), Unilever and Henkel, each selling detergents under advertised brand names such as Ariel, Tide, Omo, Surf and Persil (Wiesmann, 2006)¹. They each invest in researching consumer usage and shopping behaviour, including in relation to sustainability, for example Unilever (Shove, 2004a, Pearce, 2013) and P&G (Stalmans et al., 2007, Stalmans et al., 2013).

The vast majority of consumer detergent sales in Western European countries are made through multiple grocery retailers (supermarkets, hypermarkets and discounters) according to Euromonitor (2018a, 2018b, 2018c, 2018d, 2018e), whereas independent stores have less than 10% share of grocery sales in high income countries and this is declining (Bronnenberg and Ellickson, 2015). Multiple retailers' buyers take the lead in determining what products are stocked to meet their goals of corporate responsibility (Carrero and Valor, 2012), how they are priced, displayed and promoted (van Nierop et al., 2011) and positioned on the shelves, in terms of visibility (van Herpen et al., 2012). Retailers therefore shape and constrain choice of detergents; the purchase decision at the shelf determines what goes on to be used in the home and can influence the way in which products are used (Charter et al., 2008). Retailers also sell their own label brands, at cheaper prices, promoted through consumer messages in their shops, rather than by external consumer advertising (Mintel, 2013).

Since 1996, large European detergent manufacturers, individually, as well as through their industry association, have developed various consumer campaigns to urge consumers to reduce washing temperatures for laundry. These campaigns have ranged from TV advertising for their individual brands (e.g. Business in the Community, 2008), long term approaches to consumer behaviour change (Mylan, 2017), industry-wide on-pack messages (A.I.S.E., 2012), to a coordinated, multi-sector, pan-European consumer-facing campaign called 'I Prefer 30°', run in five countries: Belgium, Denmark, France, Italy and the UK (A.I.S.E., 2013a). These types of campaigns have been supported and encouraged by national governments, for instance, in an European Commission Recommendation (1998), in the UK (Bain et al., 2009) and through a cross-sectoral agreement in Belgium (A.I.S.E., 2013a). The size of possible reductions in greenhouse gas emissions from reduced laundry temperatures, according to three studies in Europe and the UK, is shown in Appendix A. The scale of these reductions demonstrates the importance of addressing factors influencing consumers' actions toward lower emissions in use, including the influence of manufacturers and retailers.

¹ The brand name Persil, is owned by Henkel and is their major detergent brand in many countries, for instance Germany, but licensed to Unilever for a number of countries, notably the UK.

This research examines the drivers of lower temperature washing in detail, by assessing the business strategies of laundry detergent manufacturers and retailers, examining both the technical and behavioural factors. This paper uses a coevolutionary framework, developed over time by Murmann (2003) and Foxon (2011), to analyse the factors affecting the relative success of these voluntary business initiatives. This novel approach has been adopted for this research because it allows businesses', and groups of businesses', strategies and their consumers' actions, to be analysed as interdependent entities, recognising that there are links between managerial actions, institutional influences, and technological and social interactions (Lewin et al., 1999). Coevolutionary theory complements, and adds to, Mylan's (2017) case study on P&G's approach to consumer behaviour change for lower temperature laundering, which uses stakeholder theory, institutional theory and the resource-based view of the firm.

In the next section we set out the theoretical basis for the coevolutionary analysis of 'Supply' and 'Demand' systems. Section 3 sets out the methodology used and the empirical setting for this research and Section 4 sets out the evidence and derives the linkages between the systems. Section 5 provides a discussion of the findings and Section 6 our conclusions.

2. Theoretical Basis

2.1 The coevolutionary framework used for consumer goods businesses' messages and users' practices

This research uses a coevolutionary framework to analyse the interactions and influences between systems of businesses' consumer messages and consumer laundry practices. It sets out to find system-level insights about business case drivers and how they influence, and are influenced by, consumers' responses to business communications. This is important because analyses at single company or single sector scale can miss feedback loops and influences across scales.

Coevolution has long been valued as an approach for understanding socio-technical transitions for sustainability because it both recognises the importance of cause-effect-cause loops across systems at different scales and yet the partial independence of development within systems (Kemp et al., 2007). Coevolution takes place when systems of two (or more) populations each evolve with significant mutual causal mechanisms between them, occurring in least one of the three stages of evolution (Murmann, 2003), namely, variation, selection and transmission. Thus, each system shapes, but does not determine, each other (Kemp et al., 2007). Murmann (2003, 2013) has undertaken seminal coevolutionary explanations of the history of the 60-year development of the interactions between the synthetic dye industry and the related academic system. He specifies two steps for a coevolutionary explanation, which are used in this research: firstly, that the industry and important factors of its environment can be each conceptualised as populations

that undergo evolutionary change and, secondly, that reciprocal causal mechanisms can be identified between them.

The populations here are markets comprising producers and consumers, which have been conceptualised previously as ‘supply’ and ‘demand’ systems; for instance, Safarzyńska and van den Bergh (2010) employ a formal model for demand arising from consumer preferences and for supply from the firms providing innovative products, which exhibit variation through technical change. By contrast, Kallis (2010) uses a socio-constructionist, descriptive approach, employing theoretical concepts from coevolutionary theory to connect events and interpret changes for water supply policies and water-demanding households, and it is this approach that is adopted here, to tease out plausible causal influences between the two systems.

Drawing on Murmann’s (2003, 2013) theoretical advances, Foxon (2011) developed a coevolutionary framework that provides the underpinning mental model for this research, to analyse coevolutionary interactions between user practices, business strategies, technologies, institutions and ecosystems. Hannon et al. (2012) further developed the framework by putting business strategies at the centre of the analysis. We use a similar approach here, centred on business strategies and user practices as ‘supply’ and ‘demand’ systems for consumer laundering, shown in Figure 1. The other three of the five systems are technologies, institutions and ecosystems, and these form the wider environment in this study through their interactions with the two central systems.

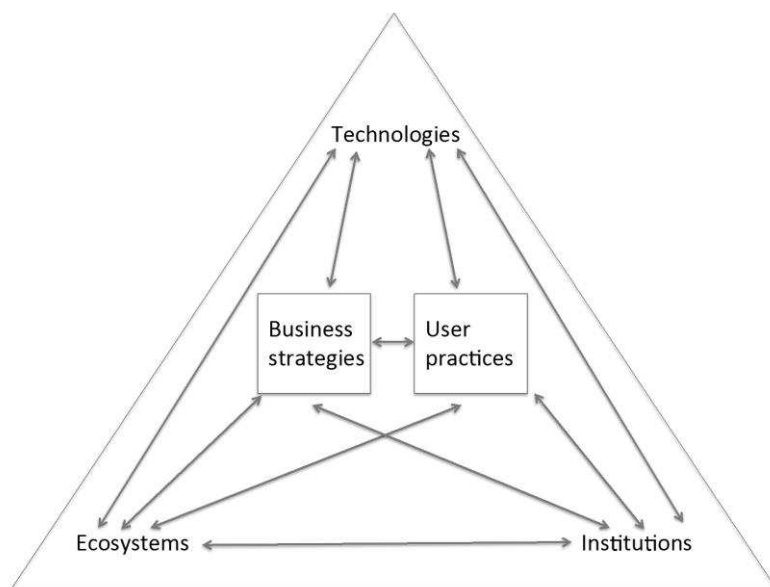


Figure 1: An integrated analytical framework illustrating the coevolutionary relationship between business strategies and the various dimensions of the wider socio-technical system

Adapted from Norgaard (1994), Foxon (2011) and Hannon et al. (2013)

This framework is used because it enables changes in business strategies for consumer messages to be interpreted and interconnected to changes in consumer laundry practices over time. The framework provides a way of examining coevolution of both systems and this is of particular interest in this case, because detergents are consumer goods that are purchased and used many times over the course of a year (Intel, 2011), in contrast to the markets for goods analysed by Safarzynska and van den Bergh (2010), which had a purchase cycle of between three and six years. The difference here is that changes in patterns of purchase and use can evolve more quickly because of the frequent purchase cycle.

The first of Murmann's (2013) two step requirements, to specify the supply and demand populations and their roles, are shown in Tables 1 and 2. We use an evolutionary perspective to deduce the processes of variation, selection and transmission (VST) in the two populations, which are business' consumer messages (supply) and users' washing practices (demand), in a similar way to Kallis (2010), and inductively infer two causal linkage mechanisms between them, as in Murmann (2013). This is useful because it combines an interpretation of events and changes with the rigour of specifying the coevolutionary mechanisms in each of two populations. Also, it allows the relative contribution between intentional actions and the results of unplanned ex post selection processes to be identified (Murmann, 2013). We now structure the remaining sections using the five systems shown in Figure 1.

Table 1: Conceptualising population level causal processes of VST (Murmann, 2013):
Consumer messages as the units of replication

Role of the system	The 'Supply' system
Population of the system	This system comprises the population of branded messages that are designed by businesses to impact consumers' behaviour to reduce laundering temperatures, a subset of their marketing and sales strategies. The businesses are detergent manufacturers (and their industry association) and retailers. These messages are the units of replication.
Sources of variation	Intentional variation, through conscious planning, is created by different businesses.
Selection processes	The outcomes arising from the communication of the messages to consumers, as perceived by the businesses, are the units of 'environmental' interaction, which lead to some of the messages being deselected.
Mechanics of transmission	Messages are transmitted through time and space in efforts to affect consumers' actions in both buying and using the products. Messages are duplicated over time either if they are perceived by the business entities as having led to successful outcomes.
Process of transformation	As certain types of messages gain prominence over time, the population of messages becomes transformed.

Table 2: Conceptualising population level causal processes of VST (Murmann, 2013):
Laundry temperatures as the units of replication

Role of the system	The 'Demand' system
Population of the system	This system comprises the population of temperatures at which households do their clothes laundering at home. These temperatures arise from the use of pre-set programmes in washing machines, the clothing, the use of detergents and pre-wash products, the time taken to do the washing, and the way in which clothes are sorted for washing.
Sources of variation	Variation increases as new ways of laundering become available through new detergent products offered for sale at supermarkets, or appliance retailers, and through households' experimentation
Selection processes	<p>First stage (shopping): Households differentially select practices, ie adopt different temperatures, based on what appliances and detergents are available for them to buy (including laws that limit the variation available), and on consumer messages. Space on retailers' shelves limits the choice available to shoppers.</p> <p>Second stage (consuming): Households differentially adopt temperatures based on the washing programmes and detergents available to them at home, having shopped, and the set of clothes they have to wash at a particular time</p>
Mechanics of transmission	New temperatures are differentially adopted over time if they are perceived as having been successful
Process of transformation	As lower temperatures gain prominence over time, the population becomes transformed

2.2 Business strategies, business case drivers and consumption emissions

Business strategies are defined as the deliberate choices made by businesses about the set of activities they will pursue in order to deliver their objectives, in their competitive context (Porter, 1985). The strategies developed for consumer messages are an important subset of consumer businesses' total strategies, deploying considerable annual resources, and demonstrated by the scale of advertising expenditure (just one element of consumer messaging). For instance, in 2010, main media advertising expenditure on washing detergents was £46.4m in the UK, 93% of which was spent by just two companies; this is 3% of the total value of market sales (Mintel, 2011).

Consumer goods companies, such as detergent manufacturers and retailers, can be positioned as the initiators of sustainable consumption (Bocken, 2017), since they seek to influence demand. Their consumer messages (the 'Supply' system) are both

a public manifestation of their brands' strategies (Gabriel and Lang, 2006) and a vital aspect of how brands seek to achieve sales growth (MacInnis et al., 2002). Consumer messages have also been used to advance consumer businesses' sustainability agendas (Bocken, 2017). We next examine the business case drivers for companies applying their marketing expertise to such messages and the influencing factors for how the messages have been constructed.

The business strategy literature for sustainability offers relevant insights about why businesses choose to pursue strategies for sustainable consumption. The firms in this research are large, public and long established; consumers purchase detergents from retailers many times each year, who, in turn, purchase them, from detergent manufacturers, many times each year, and both sets of businesses report their sales and profit results at least annually (Intel, 2011). They are run for economic purposes; therefore we used Schaltegger et al.'s (2012) framework, which recognises that firms will require a positive economic contribution from strategies for voluntary activity for sustainable consumption. Schaltegger et al. (2012) identify six core business cases drivers for analysing the drivers of voluntary activities for sustainability, derived from their extensive literature review, and having both direct and indirect influence on firms' economic performance. These are costs, sales or profit margin, risk, reputation, attractiveness as an employer and innovative capabilities, and these drivers are used to analyse the business strategies behind the consumer messaging in this research.

Many large detergent and retailer businesses have undertaken sustainability initiatives under a climate change agenda, in response to wider institutional pressures to reduce carbon emissions from their products. For example, detergent manufacturers, P&G (Saouter and van Hoof (2002)) and Unilever, have identified opportunities for reformulating detergents to require less water for rinsing (Morrison et al. (2009)). P&G undertook a sophisticated, stakeholder management approach, over several years, to achieve consumer behaviour change toward lower temperature washing and it was regarded as successful both by the firm and by many of its stakeholders (Mylan, 2017) because P&G were perceived to have led the industry, stakeholders and even to have had a significant role in influencing the institutional framework in relation to washing machines. Yet there is no public evidence or measures available of the systemic consumption emissions reductions achieved from this approach.

For retailers, Gouldson and Sullivan (2013) find considerable achievements made (in this instance, by UK supermarkets) driven by energy cost reduction opportunities, but find scope for them to take more action on indirect consumption emissions. This latter finding is consistent with Whiteman et al.'s (2012) overview of studies on corporate sustainability related to climate change, which finds good practice in carbon reporting, but a fragmented understanding of system level emission reductions by sectors, firms and in regions, including the material impacts of the consumption stage.

2.3 Laundry user practices and consumption emissions (impact on ecosystems)

Changing consumer behaviours towards more sustainable consumption is not straightforward (Jackson, 2005), because individual behaviours are strongly influenced by social and institutional factors. Indeed, different combinations of mechanisms have been shown to be effective, stemming from three different contexts in which behaviour might be changed: individual, social and material (Southerton et al., 2011) and these three contexts have been usefully summarised in a tool for social change by Darnton and Evans (2013). From the first of these, derived from behavioural economics disciplines, rational, individual, consumer benefits from lower temperature washing could be said to arise from lower environmental impacts (Laitala et al., 2011) and enhanced clothes longevity (Laitala and Boks, 2012). Yet, even for self-selecting environmentally concerned consumers, Young et al. (2010) find that their values play a relatively weak influence on the purchase decision process, compared to cultural aspects such as habits, brand strength, demographic characteristics, information shortages, lifestyles, personalities and the complexities they experience in trading off between different ethical factors. These arguments marry with findings from Abrahamse et al. (2005), in that merely providing consumers with information about rational benefits is unlikely, of itself, to lead to long term behaviour change for lower emissions.

This leads to the second and third contexts. In the social context, stemming from social psychology, people are seen as emotionally driven, and drivers to new behaviours or removal of barriers to them can be created through social mechanisms of engagement, awareness or involvement (Lorenzoni et al., 2007). In marketing to consumers, this can include social marketing (Collins et al., 2010), working with opinion leaders and through networks (Berthon et al., 2012).

The third, material, context, stemming from sociology, takes practices as its focus (Darnton and Evans, 2013). Taking this approach, Shove (2004a, p117) sees contemporary laundering as a complex, composite task 'whose accomplishment depends on the active coordination of a multitude of relatively independent sociotechnical systems' and through the construction of these systems it is 'clear that commercial rather than government organisations dominate the specification of service' (2004b, p91). This dominance is concentrated because there are relatively few large, international detergent and appliance manufacturers that sell their products to the mass market in similar ways across the world (Shove, 2004b). Considering the adoption of technological innovation for sustainable consumption, Spaargaren (2011) argues that cultural dimensions of objects and symbols are often overlooked as barriers and he includes laundering as a practice for which such analysis would have value. Darnton and Evans (2013) argue that each of these three contexts are relevant in considering how behaviours can be changed, and this research identifies aspects of each of them in its analysis.

2.4 Technologies

The system of appliances, clothing and detergents achieves a valued desire for cleanliness and freshness; a socially constructed standard of personal and domestic hygiene and appearance (Shove, 2004a), but this external outcome is achieved through ‘inconspicuous consumption’ (Shove, 2004a, p2). The interrelationships across systems of commercial businesses involved in the Clothing Use Chain are shown in Figure 2, which put the detergent business system in context.

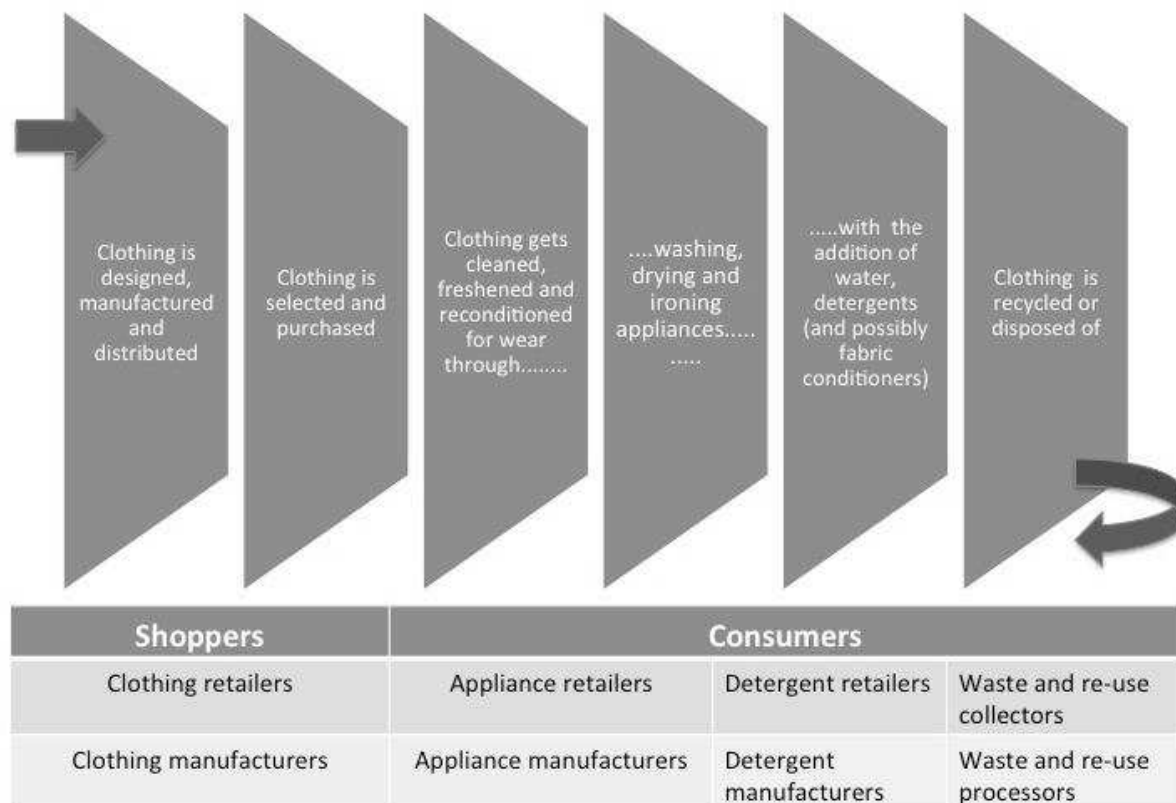


Figure 2: The Use Chain for clothing, derived from Shove (2004a), DEFRA (2010) and Morgan (2015)

Analysing data from Unilever’s own research on users in the UK, Shove (2004a) finds that there are many interdependent elements that have led to a shared understanding of what is seen as normal. These include material aspects such as the types of fabrics used for clothing, the design of household kitchens, as well as detergents themselves. Furthermore, almost all households in Western Europe have had automatic washing machines for many years (Pakula and Stamminger, 2010), and these require appropriately formulated detergents. Together these have influenced how clothes washing is done, and have contributed to the reduction of average washing temperatures, in part because washing at boiling point is not available within automatic machine programmes. However, stepping away from what has become to be regarded as normal; there may be completely different

technological processes to maintain clothes for wearability, generating substantially lower emissions. For instance, there are already machines that wash without heating large amounts of water (Xeros, 2012). Equally, clothing could be developed that would need no washing or cleaning; this would be a threat to the status quo for many established industries. The 1951 British comedy film 'Man in the White Suit'² (Mackendrick et al., 1951) brought this to life (Lees-Maffei, 2009). Given the interdependencies identified in the Clothing Use Chain, new business models would be needed to turn such inventions into successful innovations (Boons and Lüdeke-Freund, 2013).

Though it would be possible to examine the drivers of these technological changes in more detail, in our analysis, these form part of the wider environment, and we focus on the interactions between business strategies and changing user practices. We expand on and update the work of Shove (2004a) on changing laundry practices by adding examination of the behaviours, strategies and choices of actors within incumbent detergent businesses. This helps us to understand the processes of change in consumer practices, connect events and analyse an important linked system: businesses' strategies for consumer messages. Whilst Shove (2004a) identified and highlighted the role of appliance and detergent manufacturers in the specification of user practices, retailers are also influential in product choice, product use and therefore in final consumption emissions, although there are few explorations of this in the literature (Bocken and Allwood, 2012). An exception is retailers' role in sustainable use of clothing, from Goworek et al. (2012). A number of retail businesses in the UK have undertaken initiatives to reduce carbon emissions by end consumers, including in laundering, over this period (Morgan, 2015, Morgan et al., 2015). Therefore, including retailers' strategies in analysis of coevolving business strategies and consumer practices provides an important advance on the work of Shove (2004a).

2.5 Institutions

Institutions are defined by North (1990) as 'the rules of the game'. It is relevant that the selection environment for the Demand system has been influenced by legislation requirements for the washing machine appliance sector, principally European Ecodesign (European Commission, 2015) and Energy Labelling Directives (European Commission, 2010). These were designed to improve the energy efficiency of laundry appliances, through energy rating labelling, from 1996. These Directives have been effective in influencing the availability and purchasing of lower temperature washing machines (Sammer and Wüstenhagen, 2006), in part through appliance retailers' choice editing (Sustainable Consumption Roundtable, 2006). A

² The film represents a conflict between technical invention and traditional commercial interests. Its protagonist is a scientist who invents a fabric that never gets dirty or damaged. Its durability threatens the entire textile industry and is vehemently opposed by mill owners and trade unions and leads to his downfall.

subsequent refinement of these Directives explicitly required data arising from washing cycles at 40° temperatures (European Commission, 2010).

European detergent manufacturers contribute to a Brussels-based industry association (A.I.S.E.), which represents about 900 companies, from large multinationals to small SMEs, through Associations in more than 30 countries (A.I.S.E., 2013b). A.I.S.E. act as the voice of the industry in Europe, working with other organisations; it seeks to ensure stakeholder dialogue takes place in an atmosphere of trust, and to improve the economic and legal environment in which the industry operates. A.I.S.E.'s stakeholders are identified as, amongst others, the European Commission, Member States and Non-Governmental Organisations (A.I.S.E., 2013a).

A.I.S.E. have monitored trends in laundry washing temperatures over time, commissioning five quantitative, self-reported, consumer surveys, from 1997 to 2004, across 23 European countries (2003a, 2013a, 2015b). Trends have also been reported by WRAP in the UK (2012, 2017) and by Laitala et al. (2012) in Norway. Each of these studies show washing temperatures having been reduced over a five or more year period. However these surveys bear the limitations of self-reporting; there is little published data about actual temperatures, care and maintenance behaviours (McLaren et al., 2015), or about the resulting consumption emissions from the laundering sector.

3. Methodology and setting

3.1 Data Selection

The underlying intention for data collection was to analyse the influences that had led to the series of consumer messaging initiatives run over time (the 'Supply' system of Table 1), as perceived through the perspective of sales, marketing and public relations managers within detergent and retailer businesses (because these actors design their businesses' consumer messages), and the outcomes of them (the 'Demand' system of Table 2). The principle researcher sought to interview managers in these roles, who had created or deployed consumer messaging initiatives to reduce laundry temperatures in any one of five Western European countries: Belgium, Denmark, France, Italy and UK. Access to interview was given by 25 individuals who were employed by businesses (either directly or as consultants or through detergent industry associations). Primary data were thus obtained directly from 25 semi-structured interviews conducted by the principal researcher. The five countries were chosen because they each took part in a consumer communication campaign from 2014, led and coordinated by the European Association of Detergent Manufacturers (A.I.S.E), called 'I Prefer 30' (IP30), which provided both one of the communication campaigns and a rationale for contacting potential respondents. The interview guide was developed using Schaltegger et al.'s (2012) business case drivers and Foxon's (2011) five coevolutionary systems. A summary of the

respondents and the interview structure are shown in Appendices Bi and Bii. There were three further sources of data; the first of which was provided by A.I.S.E. itself and comprised both published and unpublished data, about a number of their initiatives to reduce laundry-washing temperatures across Europe, including publicly available reports from 1998 to 2015. An agreement was made between the University of Leeds and A.I.S.E., which allowed access to A.I.S.E.'s private data and to individuals who had been involved in its consumer-facing initiatives³. A further source of data was publicly available, relating to low temperature washing in activities from 2000 to 2014, from corporate reports, press releases, video footage, journal papers and published interviews from large detergent manufacturers and individual employees, and from three of the largest UK clothing retailers. Finally, these data were augmented by secondary data for the Demand system in Table 2, collected during the research process from the Sustainable Clothing Action Plan (WRAP, 2015) and from independent market research, audit companies and from qualitative and quantitative reports about how the initiatives were perceived and acted upon by consumers, commissioned by A.I.S.E., its members, and its business partners, and made available subsequently to the principle researcher on a selective basis. It was not possible to collect primary consumer data in this research, due to time and budget constraints. However, A.I.S.E. provided consumer data from their five surveys of 200 respondents in each of 23 countries, across the period from 1997 to 2014. These data are substantial, but were not collected for this research analysis and are framed by the A.I.S.E. design of the sample and questionnaire. It is important to note that, though we have conceptualised changes in consumer behaviour from a social practice perspective in this study, the collection of this consumer data was framed within an individual-level rational choice perspective.

3.2 Data analysis

Data were analysed to determine changes in manufacturing and retailing businesses' strategies for consumer messages over a period of eighteen years to 2014. Company reports, press articles, A.I.S.E. data and videos were searched individually for statements or phrases that included the key words: emissions, carbon, user, consumer, customer, temperature, detergent, washing, in order to identify businesses' strategies for consumer messaging. From this, a 'history' of what the consumer messaging had been was developed for A.I.S.E., for each of the three large international detergent companies and for Marks & Spencer, the leading UK clothes retailer.

Interviews were recorded and transcribed and the transcriptions input into a proprietary software programme, NVIVO, to support rigorous coding (Welsh, 2002). Codes were deduced from each of two theoretical standpoints. Firstly, instances of

³ The agreement included access to certain confidential information and opportunity to approach individuals for interview. In exchange for access, the principle researcher agreed to prepare a draft of the final report for the IP30 initiative, as a Consultant, and was paid expenses for one visit to A.I.S.E.'s offices in Brussels in order to gather information for the report writing. No other funding was sought or received.

the causal processes of variation, selection, and transmission (VST) were identified from the descriptions given in Tables 1 and 2, and coded; the selection coding was subdivided into 'shopping' and 'consuming' (Demand system), 'manufacturer' and 'retailer' (Supply system). Secondly, the underlying business strategy motivations behind the consumer messaging initiatives were coded according to Schaltegger et al.'s (2012) six core business case drivers.

3.3 The empirical research setting

We have set out the context for this research as a map of supply and demand systems, following Murmann's (2013) first step to specify concrete instances of variation, selection and transmission processes and as specified in Tables 1 and 2. We take the population that is 'supplied' to be the set of consumer messages designed by businesses to influence consumer behaviour to wash their clothes at lower temperatures. These messages are purposeful and voluntary interventions directed to consumers, guided by businesses' strategies, and delivered through a wide range of mechanics, such as advertising, in-store promotions, product labelling, information printed on packs, paid-for editorials, social media and websites. The population that is 'demanded' is the consumer practices relating to the set of temperatures at which household clothes laundering are accomplished. Having taken the first step of conceptualising the populations of businesses' consumer messages and user practices as two evolving systems, we then identify the linkage mechanisms between them inductively, as done by Murmann (2013).

3.4 Identifying patterns and linkages

The potential consumer benefits that were communicated within the messaging were identified from the data, and six codes derived inductively from these. In another stage of inductive coding, linkages were identified between the business strategies for consumer messages consumer practices, over the twenty-year period. The coding scheme is shown in Table 3.

Table 3: Codes used for analysis

Supply system: Consumer messages	Variation Selection - manufacturer Selection - retailer Transmission
Demand system: User practices	Variation Selection - shopping Selection - consuming Transmission
Business case drivers from Schaltegger et al. (2012)	Attractiveness as employer Costs and cost reduction Innovative capabilities Reputation and brand value Risk and risk reduction Sales and profit margin
Consumer benefits communicated emerging inductively	Better clothes care Cleaning performance Convenience and ease of use Energy or emissions saving Generally expressed environmental benefits
Linkage mechanisms emerging inductively	Money saving Consumer research and direct feedback Short term sales performance

4. Results

This section describes the results, illustrated by quotes from interview responses. The findings were analysed looking first at the Supply system, businesses' consumer messages, and drawing on the history of the initiatives from coding the content of the consumer messaging, and the underlying business case drivers. The Demand system, consumer laundry practices, was then analysed through the ways in which laundry temperatures had been influenced. The emergent causal linkage mechanisms across the Supply and Demand systems are then identified. The analysis uses quotations from the interviews to illustrate key points.

We describe how laundry temperature selection is an outcome of shopping and using phases. The focus is on population changes, message competition and linkages between the supply and demand, and then to identify the extent to which the key linkages have affected user practices and businesses' strategies. We do not

seek to prove that these are the only possible maps for the fundamental evolutionary mechanics of the populations, but are used to find causal mechanisms between the systems, in order to create useful insights for future design of messaging interventions for behaviour change in consumer markets, through businesses.

4.1 The Supply system

Since the 1990s the major detergent manufacturers have used their considerable scientific expertise to be at the forefront of designing products for improved sustainability. Technologically sophisticated enzymes (which can act as catalysts to speed up chemical reactions) enabled reductions in washing temperatures (A.I.S.E., 2013a) and variations in technologies available to consumers. Separately, manufacturers' scientists had identified the importance of carbon emissions from the use phase of the lifecycle, for example by Saouter and van Hoof (2002) (data from P&G, having identified that 80% of energy consumption associated with laundry detergents in Belgium occurs during consumer use). A further benefit of increased use of enzymes is that the physical bulk of the detergents could be reduced (Novozymes, 2016).

As businesses sought to improve perceptions of their sustainability, the industry has also developed a narrative that concentrated product formats are beneficial to consumers due to their general environmental benefits, for example by reducing consumption of resources (same number of washes with less resources per pack), reduction in packaging and pack sizes, and lower emissions in transport (Dombek-Keith and Loker, 2011). This narrative demonstrates the rational, individual context, and combined with the capacity of these products to perform well at lower temperatures, saves consumers carbon emissions, energy or energy costs per wash, whilst also prolonging the life of the clothes (A.I.S.E., 2013a). However there are also cost reductions in packaging and in transport, which drove business cases for manufacturers, from the early 2000's, whilst being in alignment with consumer environmental messaging:

'If you take something like Ariel, we have a gel which you can use at low temperatures and is very concentrated.....When we ship it, it's got as much as 45pc less packaging and you need 50pc less truck space. When the consumer washes their clothes, they use 20pc to 50pc less energy depending which temperature they choose.'

Huw Waters, Product Supply Director, P&G (Wilson, 2012, online)

Manufacturers saw this as a 'win-win' (Bocken and Allwood, 2012, Mylan, 2017). It is also a 'win-win' for retailers because it results in higher value products per unit of shelf space:

'Retailers welcomed compact detergents because it freed up shelf space and the overall mission of a retailer has to be to maximise the upturn from shelf

area.. so if someone says I'm going to take less space....they're going to bite your hand off really.'

(Author interview with Consultant to large UK retailer, July, 2014)

Over an extended period, individual detergent manufacturing businesses ran specific consumer communication campaigns setting out various benefits of low temperature washing, for their brands. These were referred to in their Sustainability Reports: Unilever 2002-2015 (Unilever, 2017), P&G 2006-2012 (Procter and Gamble, 2017) and Henkel 2009-2015 (Henkel, 2017).

However there is variation in detergent manufacturers' business strategies for consumer messages, arising from differing technological, marketing and selling capabilities and from differing strategic preferences, and, in part, from different geographical retailing contexts for the businesses (Sullivan and Gouldson, 2016). For example, P&G, as a US based company, are more strongly influenced by Walmart, whereas Unilever have almost no presence in the US (The Economist, 2012). Walmart, the largest retailer in the world, had developed a policy for the United States from 2009 to eliminate the large physical packs required for dilute detergents, in the interests of sustainability (Crawford, 2013).

Different strategies are exhibited through different product formats and branded approaches to consumer persuasion, for instance, advertising, packaging design and promotions.

In parallel with individual businesses, A.I.S.E. also developed initiatives that resulted in consumer messages being delivered across Europe. In 1997 A.I.S.E. created the consumer-facing 'Washright©' campaign to raise awareness amongst the industry's consumers of the benefits of changing their washing habits, including reducing laundry-washing temperatures, and from 1998 onwards, over 90% of European household laundry detergent packs displayed this message (A.I.S.E., 2003b). The campaign was also advertised in printed media in many languages, and included a multi-lingual website. From 2000 to 2002, A.I.S.E. developed a pan-European television advertising campaign to promote the Washright© message, at an estimated cost said, in 2002, to be €10m equivalent each year (A.I.S.E., 2003b).

In 2012, A.I.S.E. started to develop a new consumer campaign called 'I Prefer 30°' (IP30), effective during 2014, in five European countries: Belgium, Denmark, France, Italy and the United Kingdom. This initiative was implemented not only through detergent manufacturers, but also retailers, appliance and textile companies, trade associations and government authorities were invited to contribute and use IP30 branding themselves, thus involving a wide variety of stakeholders in its outcomes. It was repeated in four countries (as earlier, but excluding Italy) during 2016 (A.I.S.E., 2015b).

We have seen that cost reduction has been a business case driver. Two more of Schaltegger et al.'s (2012) drivers emerged strongly from the data; reputation and sales or profit. The reputation of a brand is a competitive tool:

'Although a number of other companies added their own 'turn to 30' messages by the second year, independent research showed that 88 percent of consumers who changed their behaviour to wash clothes at 30 degrees associated the message with Ariel.'

(Case study on P&G, (Business in the Community, 2008))

This, perversely, has the effect that a 'turn to 30' message was not selected by competitive brands to use for themselves, because it would not give them a competitively differentiated reputation benefit:

'P&G [Ariel] was the first to do it so either you go one better than P&G somehow, by saying don't wash at 30, but wash with cold water, or you say no, let's do this on a industry scale,this competitive element that started the whole movement, is being eroded by others and you can see how the different companies' interests don't align.'

(Author interview with International Corporate Responsibility Manager, partner company, March, 2015)

Retailers, most of which also sell clothes as well as household goods and food, are also sensitive to the impact that failures of detergent products in the past have had for their own reputation for clothes quality:

'The reason for [leading retailer] being interested in detergents came from the reformulation of detergents with an aggressive action that damaged clothes. This resulted in garments being returned to us as being faulty.'

(Email response from Sustainability Manager, UK retailer, June, 2014)

Businesses seek feedback assiduously in order to understand their reputation with their customers:

"Practically every minute of every day, somebody in our business is asking shoppers and customers what they think against a number of different measures. And how they respond to promotions, what they think of products...."

(Author interview with PR Manager, large UK retailer, July, 2014)

Of the other business case drivers, sales (or profit) was critical for respondents in commercial roles:

'In terms of those measures of success as a sales organisation; it's what it done for us in terms of the sales line.'

(Author interview with Marketing Manager, detergent manufacturer, April, 2015)

Individuals' personal success is linked to the short-term sales revenue generated from the area of business for which they are responsible. So, the strategies and tactics that generate growth in sales revenue and profits are repeated over time. We found also that commercial successes and failures are highly visible within, and across, the small number of large retail and detergent businesses in each country, with high awareness of successes and failures of competitors across and between both sets of businesses.

For respondents in technical or communications roles, however, there was frequent recognition that more senior managers in the company had to manage a balance between sales or profit and reputation:

'Senior management....playing the reputation about being a good corporate partner to government, to customers...and of course that directly leads into sales and profit because people think well of you and therefore they want to come and shop with you....'

(Author interview with PR Manager, large UK retailer, July, 2014)

' "I prefer 30" was a sustainable message, one that we had to support ... but in terms of its success at a very business level I'm not sure that we ever thought it would move the dial.'

(Author interview with Marketing Manager, detergent manufacturer, April, 2015)

Since all manufacturers' sales are made indirectly, through retailers, it is through retailers that they measure their success. Yet retailers do not see environmental messages as being sufficiently strong to deliver increased sales. It was explained that a major retailer did not take up IP30 because:

'they [retailers] have to free up what is very valuable space and to use that for a campaign that's not..... it's hard to justify, given that it's not really going to move the sales line itself versus a price promotion....'.

(Author interview with Marketing Manager, detergent manufacturer, April, 2015).

Therefore we have seen that manufacturers' strategies themselves are constrained or enabled by retailers' distribution, shelf allocation and promotional strategies.

Appendix C summarises the relative importance of business case drivers for consumer messages, according to respondents. Reputation (both corporate and brand) was seen as the most important driver, followed by 'sales and profit margin' and 'costs and cost reduction'. 'Innovative capabilities', 'Risk and risk reduction' and 'Attractiveness as an employer' were seen as less important drivers.

Businesses' managers do not see themselves as 'all knowing'. Even having done their own market research, they do not know beforehand how successful their deployed strategies are going to be until they are tested in the market against competitors. If a strategy damages sales, profit, corporate or brand reputation, it can be, and is, quickly changed. None of the other drivers (innovation, risk and employee attractiveness) were thought to be important, even when prompted.

4.2: The Demand System: How detergent manufacturers and retailers' perceive that laundry temperatures are influenced

From the Clothing Use Chain, there are two stages that result in detergent use. The first is that the detergent has to be selected by shopping through a retailer before the second stage, when it is selected for use at home, almost always in a washing machine, whose set of programmes limits washing temperature choices.

At the shopping stage, businesses perceive variation in purchasing of detergent products arising because of different, individual, consumer preferences for brand, or format (powder, tablet or gel), or fragrance, or price and other product attributes, which include environmental claims. According to respondents, shoppers' choices, from what is made available on the retailers' shelves, are made from habit (influenced by brand and format loyalty), from the product's price, and their perceptions of performance to achieve the desired cleaning results. Price is clearly set out on the shelves; perceived product performance information comes from advertising, shelf and pack claims and previous use experience. Respondents declared that consumers find shopping for detergents uninteresting, to be done with speed, and want retailers to make it easy to find and choose quickly. For the majority of shopping decisions, products are selected from a small repertoire of previously used brands. However, a new, low-priced detergent, for instance a retailer's own brand, may provoke an experimental purchase.

From the early 2000s, messages about the environmental impact of detergents are said by respondents to have played a role in the shoppers' decision hierarchy. However, these aspects are not perceived by them to be the primary drivers of purchase. This may be self-fulfilling, in that firms choose not to communicate environmental benefit as a primary claim, and acknowledgement by them that the individual context for behaviour change is not effective. Nonetheless, it is noted that the campaign from A.I.S.E. (2015a) did include some social marketing and used opinion leaders, which shows an understanding of the social context of behaviour change.

The use stage, home laundering, is also seen by users as an uninteresting task. However, its material context has evolved over time; lower temperature washing has been seen to be increasingly acceptable as machines and clothing has changed. For most clothing, most of the time, laundering has become a freshening and hygiene-maintenance process, rather than a dirt-removal process. In automatic washing machines, boiling clothes at 90° was no longer possible, so lower temperatures became normalised as the machines became more widespread. EU Directives (2010) aiming to reduce energy use of appliances influenced this process and pre-set washing machine programmes using lower temperatures became universally available; consumer research indicated that this was a welcome development because fading and shrinkages were common at high temperatures. Also clothing has been made increasingly from fabrics that can be washed at lower temperatures; in light of this, clothing retailers have reduced the temperatures at which they test their garments, thus accepting new configurations of textiles and trimmings, which may not have passed retailers' earlier standards for clothing. Notwithstanding the known advantages of abandoning the very high temperature washing of the past, there is evidence of a widespread consumer view that higher temperature gives better results in terms of both hygiene and cleaning performance; this gives rise to a tension between the desired, higher order, benefit of clean clothes, and the environmental or cost benefit of using lower temperatures.

Six types of benefits of washing at lower temperatures for individuals were identified from the research in the messages for consumers: saving money, improving cleaning performance, saving energy or emissions, benefitting the environment, improving convenience and ease of use, and improving clothing care. Appendix D summarises the relative importance of the benefits, according to the business respondents.

It is worth noting especially that saving money is considered least important as a motivating message by these business interviewees:

'the amount of money that you would save, the consumer would save, in the year by washing at 30 degrees, is £38. There's all sorts of questions about £38; it's a night out; it's not very much money. And again it's not why you would buy a product.'

(Author interview with Former Sustainability Manager, UK retailer, March, 2014)

Furthermore, Unilever's Marketing Director has publicly stated that the competitor's (P&G) campaign for Ariel called 'Turn to 30', focused on energy saving benefits, did not change behaviour (Charles, 2010). This view was derived from market research carried out by the firm, in which consumers placed electronic chips in their washing machines to measure the temperature and length of washes.

The effect of EU appliance labelling legislation (European Commission, 2010) has been that it favoured appliance manufacturers who had more efficient programmes at 40° or below. Also, since 2010, newly installed machines have at least one programme that washes at temperatures of 20° or below. This exemplifies the context, in that the machines now enable low temperature washing. Before these machines were widely in use, there had been a fear amongst both clothing and grocery retailers that 'wash at 30' messages would limit their sales because consumers would text the message literally and not buy clothing or detergents bearing this instruction if their machine did not have a suitable programme at 30 degrees.

4.3 Two mechanisms of coevolution between business strategies for consumer messages and consumer use practices in domestic laundering: 1996-2014

Having set out the evolutionary mechanisms within two populations, namely business strategies for consumer messages and user laundry practices, we now analyse the key events in the recent evolutionary histories of each of these populations, and interpret the linkages between changes in the two populations. Figure 3 provides a causal map of the coevolutionary dynamics between the two populations, showing a simplified timeline of key events and interactions between the business strategies for consumer messages and changes in laundry temperatures, following the template in Murmann (2013). There are important links between detergent availability through retailers, detergent selection and use, and the links with retailers' strategies that impact the availability of product sizes. Figure 3 also includes a snap shot of other coevolutionary influences arising from changes in technologies and institutions.

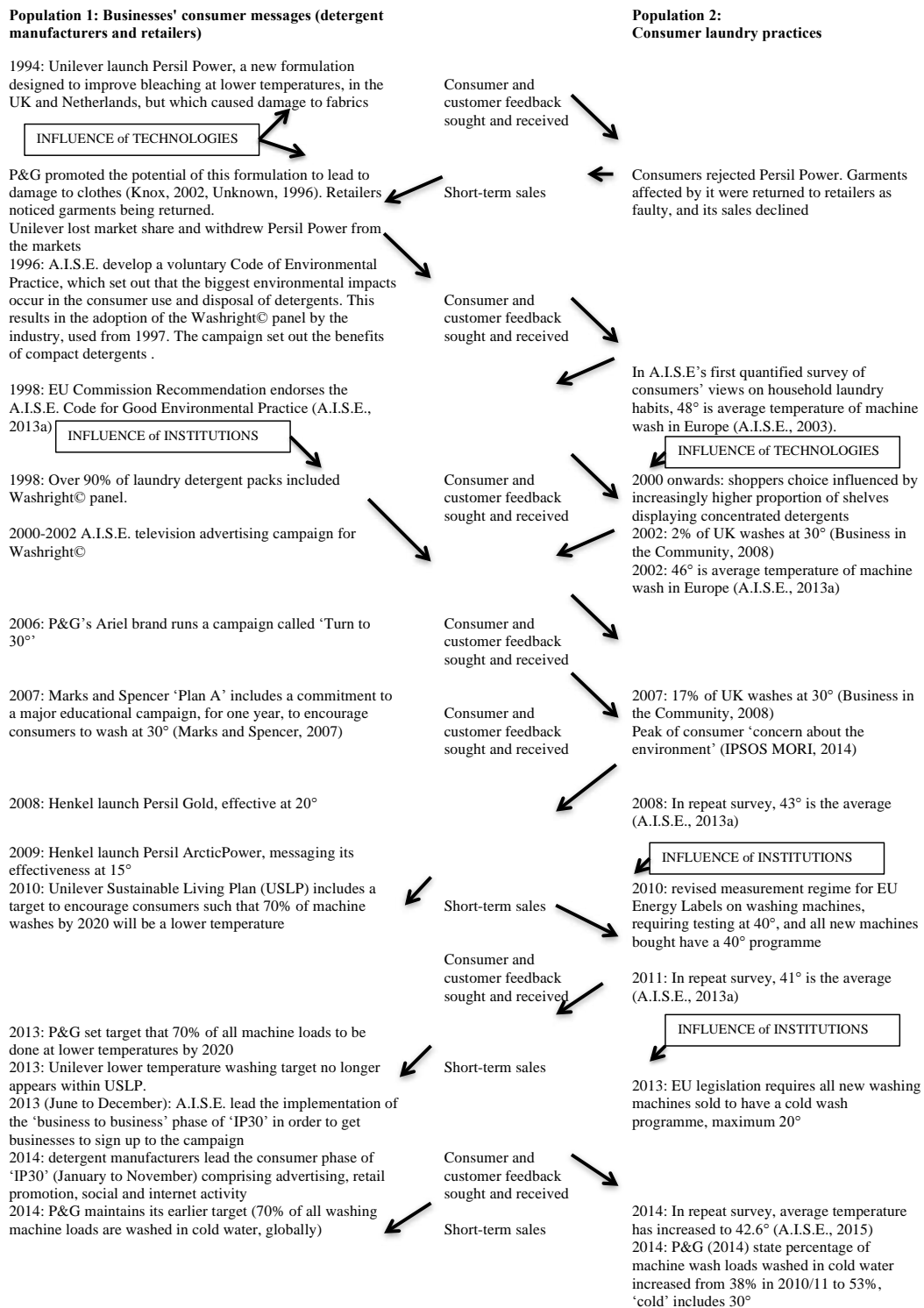


Figure 3: Map of coevolutionary dynamics, showing two linkage mechanisms, developed by authors, following Murmann (2013)

From the coding, we identify two linkage mechanisms identified as operating between the Supply and Demand evolutionary systems. These are short-term sales and consumer/customer feedback; together these drive the coevolutionary interactions between the two populations. Customers initiate short-term sales by purchasing at retailers; retailers and manufacturers measure those sales, and this is what forms the first linkage. Businesses (either detergent manufacturers or retailers) initiate consumer/customer feedback and subsequently analyse the results; this is what forms the second linkage. We now look at these each in more detail.

4.3.1 Short-term sales

Based on our evidence, and on businesses' consumer research, cleaning performance is seen by the businesses as the leading functional benefit in determining consumers' detergent choice, and is institutionally embedded as a major element of what they seek to communicate. Technological innovation has enabled detergent manufacturers to promote compact detergents' cleaning performance, and influenced their increased availability by retailers, in turn, influencing consumers to buy and use them. Over the same period, washing machine manufacturers developed and promoted washing machines designed to wash effectively at temperatures below 40°. Therefore lower temperature washing has occurred principally because both detergents and machines to do so were easily available, better advertised and price-promoted, and delivered good cleaning performance, rather than because consumers selected detergents primarily on the basis that they were effective at lower temperatures.

The picture that emerges is that consumers' behaviour has been driven by perceived cleaning performance and value for money of detergents, not by lower environmental impact or saving money on energy. After P&G's 'Turn to 30' campaign' (Business in the Community, 2008), other brands have not led with the benefits of reduced washing temperature in their advertising, as also acknowledged also by Mylan (2017). This is in part because it would not be competitively distinctive, but also that firm's managers believed that this messaging would neither increase short-term sales, nor be effective in changing behaviour. Nonetheless, the IP30 initiative was subsequently funded by the manufacturers (at European association level), but at lower expenditure than they would typically spend on their brands.

Mass-market grocery retailers stock conventional, well known branded products, measuring success by sales revenue and profitability per square metre of shelf space; there is less shopper demand for less well-known brands, including those for whom the consumer message is principally an environmental one. Large established detergent manufacturers seek to emphasise to retailers' buyers the benefits to retailers of their brands' high rate of sales and profitability, in turn benefitting retailers' short-term business performance. This discourages buyers from giving space to more niche alternatives in their stores. Therefore manufacturers of these smaller brands seek distribution through alternative channels; specialist 'natural'

stores, upmarket department stores, or on-line sites, thus further marginalising their appeal and availability to mass-market consumers.

4.3.2 Consumer and customer feedback

An important example of consumer feedback is A.I.S.E.-commissioned consumer research, which included gathering self-reported temperature selection, in five quantitative surveys from 1997 to 2014. From these, average temperatures of a machine wash in Europe reduced from 48° (1997), to 46° (2002), to 43° (2008), to 41° (2011) and increased to 42.6°C (2014), due to a decline in the number of colder washes. Both these research results, and other qualitative consumer research surveys made available to the researcher (but not in the public domain), show that progressively lower temperatures are not being achieved more recently. This research has also indicated that consumers themselves do not perceive that their own behaviour has the potential to substantially reduce carbon emissions and it does not drive their brand choice, consistent with Young et al.'s (2010) findings.

4.4 The Linkage Mechanisms

We have defined the three evolutionary processes of selection, variation and transmission, in each of two populations, and identified inductively the two causal processes, namely 'short term sales' and 'consumer and customer feedback'. Following Murmann (2013), we have identified these two causal mechanisms with an effect on either the evolution of the consumer messages and on user practices, so there are a possible twelve causal effects on their variation, selection and transmission. These are shown in Table 4 and Figure 4, based on Murmann's 'Mechanisms of Coevolution' (ibid.) and illustrate where we have found evidence for eleven out of these twelve possible causal effects.

Table 4

Causal Mechanisms and Their Effects on the Evolution of Consumer Messages and User Practices

Short term sales		Consumer and customer feedback	
Consumer Messages	User Practices	Consumer Messages	User Practices
Variation			
Sales arising from users' purchases and use patterns prompt sales and marketing managers to devise new consumer messages about environmentally friendly behaviour	Consumer messages generated by businesses give users ideas for new ways of using detergents	Feedback and suggestions from consumer and shopper market research leads to new messages being communicated	Not observed
Selection			
Messages that are perceived to generate the best sales (in relation to competitors' sales performances) are likely to be used. Retailers select products for their shelves by judging which messages will generate most sales revenue in the space available	Users buy detergents based on the messages that they perceive will meet their needs, amongst all those on display	Types of consumer messages that are well perceived by retailers' buyers and in consumer and shopper market research are adopted in the limited space or resource available, on pack, on shelves and in advertising.	Users feedback to retailers and manufacturers which brands they consider to be in the repertoire of the ones they will buy
Transmission			
Businesses' consumer messages that are thought to have contributed to generating sales are retained	Users who feel that the detergents' messages have been fulfilled in use will buy and use them again	Businesses' consumer messages that are replicated over time will more readily be fed back by users, through, for example, their loyalty to particular brands	Users retain loyalty to certain brands on the basis of their features and benefits, as they perceive them

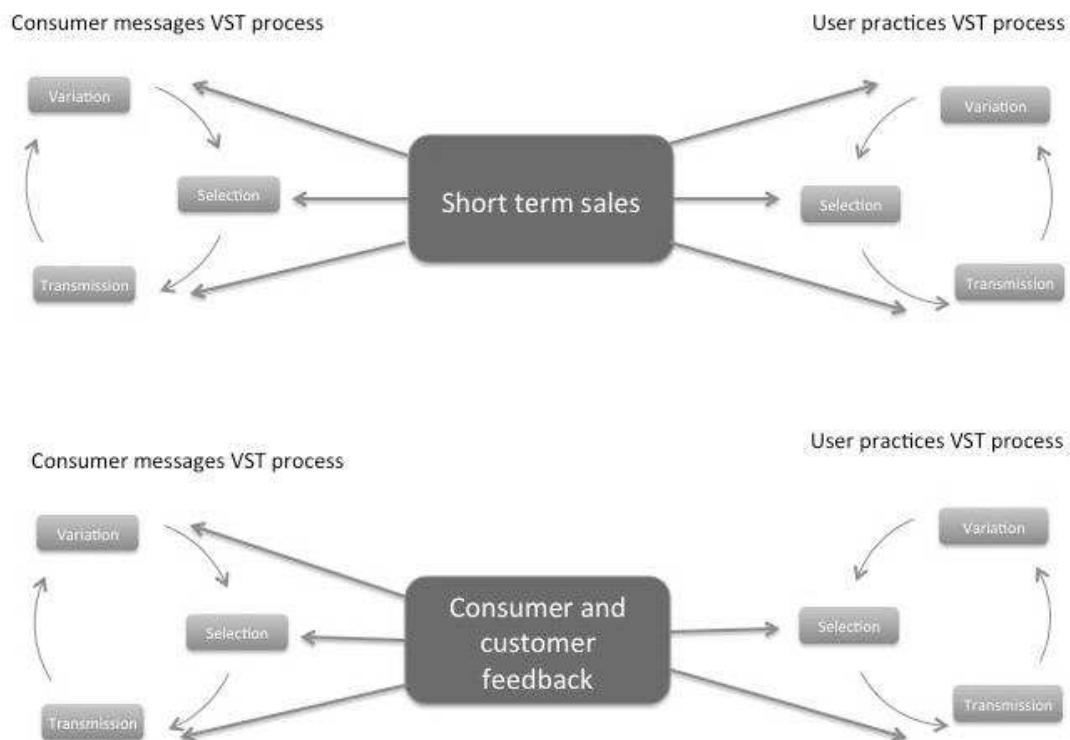


Figure 4: Two Mechanisms of Coevolution

4.5 Coevolutionary influences and the role of other processes

The focus here has been on businesses messages from detergent manufacturers and their impact on consumer practice. However, it is noted that there has been a linked, progressive reduction in the size of detergent cartons on shelf, due to technology, which has benefitted consumers because of convenience and the ability to wash at lower temperatures, but also offered cost reductions for manufacturers and retailers.

Also, the European Union and national governments have taken action to reduce carbon emissions through legislation on labelling of appliances. In addition, the research has identified that some governments have provided endorsement and encouragement for detergent manufacturers to promote low temperature washing. The data suggests that coevolutionary influences of at least equal importance to user practices have arisen from these institutional actions.

5. Discussion

We have found that this coevolutionary analysis of the supply and demand systems has challenged the simplistic narrative that detergent manufacturers have driven washing temperatures down in order to achieve environmental benefits. The

benefits of washing temperature reduction do not feature as important aspects of selection for detergent manufacturers, retailers or their consumers. The requirement for ever-improving commercial performance, measured by sales and profit, inhibits radical diversion from conventional strategies, and is in tension with influencing consumer behaviour for environmental ends, unless there is a commercial advantage too. Furthermore, businesses' perception that cleaning performance is the key driver of consumer choice is continually reinforced in consumer messaging, and this has led to path dependency, serving to limit technological variation. This research therefore has added to Mylan's valuable findings in two ways; firstly by introducing the important drivers and barriers that emerge from taking account of the influence of retailers, and secondly by taking a wider, systematic, perspective of the reasons for the outcomes than those drawn from a case study of a single firm.

The coevolutionary analysis presented here has also built upon Shove's work (2004a, 2004b). She showed how systemic processes, leading to the dominance of domestically installed washing machines and manufactured detergents, influence user practices. We have shown coevolutionary selection pressures arising from the system through which retailers interact with manufacturers, through a close examination of initiatives designed to reduce laundry temperatures, over a shorter and more recent time period, and that there are also both technological and institutional influences. This research suggests that progressive regulation for appliance energy use, leading to changes in machines and in washing programmes installed in them, has been a main reason for wash temperature reductions in Europe.

Detergent manufacturers and retailers have implemented strategies to present consumers with the benefits of low temperature laundering. Over the same period, EU directives on the labelling and design of washing machines have normalised lower temperature washing. This analysis suggests that commercial selection pressures have limited the impact that consumer messages have had on consumer behaviour. This can be seen in the light of the two identified mechanisms. Firstly, manufacturers' and retailers' need for short term sales have led to the low temperature messages being weak in the context of other, more motivating, consumer messages. Secondly, feedback to manufacturers from both retail customers and consumers is that a lower washing temperature is not a compelling reason for selection, compared to other consumer benefits. Business respondents feel that they can influence environmental behaviour only within the realms of what is compelling for customers and consumers. Washing temperatures have, nevertheless, reduced to an extent over the whole period of analysis, consistent with the availability and promotion of technically improved appliances and detergents able to wash at low temperatures. This aligns with what has been described earlier as the material context for consumer behaviour change. It seems that further restructuring of physical characteristics, in tandem with establishing new cultural, social and emotional norms, will be necessary, to drive substantial behaviour change.

The research finds that, of Schaltegger et al.'s (2012) business case drivers, reputation and sales and profit are the most important here, the latter strongly influenced by cost reduction opportunities. This research suggests that corporate risk, innovative capabilities or employer attractiveness are much weaker drivers. It may be that fast moving consumer goods businesses, both manufacturing and retailing, are especially sensitive to reputation and short-term sales and profit. The two linkages that emerged inductively from the data can be seen as subsets of two of Schaltegger et al.'s (2012) six drivers; short-term sales being related to the driver of sales, and consumer feedback, which is linked to reputation and brand value, as perceived by decision-makers in both manufacturers and retailers.

Schaltegger et al.'s (2012) business case driver framework provided clear categorisation, to which it was easy for interviewees to respond, and from which relevant codes for analysis could be developed. The inclusion of the consumption outcomes, indicated by the washing temperature survey, complemented it. The Clothing Use Chain was further validated, since clear influences across and between industries within it were identified.

A limitation of this research is that it examines the consumer behaviour change responses through the eyes of businesses' managers rather than direct evaluation of consumer campaigns. It could be well complemented by research amongst consumers to explore influencing factors for detergent choice and use. Further limitations of the research emerged with respect to data access. Firstly, it was difficult to gain access to information from the businesses in these sectors. The detergent manufacturer respondents are limited to those who agreed through A.I.S.E., having taken part in the IP30 activity. It is likely that the job roles of the respondents shaped their responses and may have influenced the results. It would have been valuable to have data from others who had chosen not to take part in AISE's initiative. There was also insufficient data by country to make valid comparisons between them about the ways in which A.I.S.E. campaigns influenced, and were influenced by, businesses, consumers and institutions. This would also have been of value, since significant differences were noted in both average laundry temperatures across countries and in the implementation activities and messages of the IP30 campaign, led by different A.I.S.E. organisations in different countries.

Other limitations arose because secondary data obtained from businesses had been selected by them and therefore may have excluded commercially sensitive aspects. Whilst the consumer market research studies made available to the researcher had been undertaken by professional market research agencies, they were designed by the detergent industry for their own purposes, have not been independently validated, and their qualitative conclusions may have been influenced by our respondents' own perspectives. Thus, the consumer data was partially independent and partially construed by interviewees. Nonetheless, there was a universal consistency from the data that neither emissions, nor energy, nor in-use cost reductions are a major driver for consumers' detergent purchasing.

6. Conclusions

We conclude that, in spite of good intentions and considerable efforts and resources, neither consumer nor business initiatives will drive sufficient change, either separately or together, to deliver the scale of reduction in carbon emissions across the multiple systems that make up domestic laundering that would be consistent with European aspirations to reduce emissions by 20% by 2020, and higher carbon emission reduction targets in future years. The narrative of progress and achievement from the detergent industry is by no means unwarranted. However, actions of policy makers and the 'win-win' advantages of new technologies have been seen to have been at least as influential as consumer communication initiatives of the detergent industry, although all these are linked in our coevolutionary explanation.

Our conclusion has implications for policy aiming to reduce consumption emissions at scale, where it relies on voluntary actions from businesses and consumers. This research suggests that policy could be developed that recognises system-level interactions: to include deeper encouragement for joint efforts between policymakers, industries and stakeholders to develop more effective drivers for consumer behaviour change and to link these to regulatory mechanisms, for example for washing machine appliances.

Through linking our analysis with business strategy literature, we have identified business case drivers relevant to consumer behaviour change, in the context of the commercial selection pressures that consumer businesses face. We have provided directional coevolutionary explanations for changes in the ways detergents have been presented to consumers over a 20-year period. Path dependencies arise across and between manufacturers and retailers and their consumers because of cross-industry narratives that serve to limit the variation of products created, because of selection pressures, and because of transmission of habits for products that do not hold the interest of consumers. We have shown also that retailers are highly influential within the system of what is made available to consumers.

Reflecting on the use of the theoretical frameworks, the use of a coevolutionary framework, together with theories of business model innovation and social practices, was able to shed new light on the two systems. The merit of the coevolutionary analysis is that we were able to inductively infer the process of change across the systems, by piecing together the story of that change, through combining documentary analysis with interviews, and identifying and mapping coevolutionary linkages. In addition, the coevolutionary approach, with the business case drivers for sustainability framework, has bridged intentional actions and ex post selection processes (Murmann, 2013) as explanations of firms' strategies in a market where manufacturers compete for retailers' space and consumer sales, and consumer practices are influenced by wider social, material and cultural factors, as well as directly by messages from businesses. It thus contributes to the field of sustainable

consumption through bringing these frameworks together for analysis of whole systems of competing businesses' strategies in context with technologies, institutions and ecosystems.

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Appendix A

Possible reductions in greenhouse gas emissions available from reduced laundry temperatures, selected figures

Geographical scope	Scenario	Outcome
UK (Bain et al., 2009)	If all UK citizens washing clothes at 40°C washed them instead at 30°C	UK would save 12% of energy currently consumed on clothes washing, equivalent to 0.22 MtCO ₂ per annum
UK (Thomas et al., 2012)	If the weighted average wash temperature became 39.3°C instead of 46°C	There would be a reduction of 0.55 MtCO ₂ per annum
EU27 (Beton et al., 2014)	If the average washing temperature became 32.9°C instead of 45.8°C	There would be a reduction of 10.9%, or 20 MtCO ₂ e

Appendix Bi

Summary of respondents by type and country

	Respondent code name and date	Form of response	Country of residence at time of response	Respondent role, generalised title in order to maintain anonymity
1	Apricot March 2014	Face to face	UK	Former Sustainability Manager, large UK retailer
2	Banana June 2014	Email response to questionnaire	UK	Sustainability Manager, large UK retailer
3	Chilli	Face to face	UK	Sustainability Manager, large UK retailer
4	Damson July 2014	Face to face and email follow up for further clarification	UK	Consultant who worked with one major international detergent manufacturer on sustainable consumption over ten years
5	Eggplant July 2014	Face to face	UK	Consultant who worked with major UK retailer on carbon labelling scheme
6	Fig July 2014	Phone	UK	PR manager, major UK retailer
7	Greengage July 2014	Phone	UK	Consultant who worked with both detergent industry companies and DEFRA
8	Hop July 2014	Phone	UK	Consultant who worked with international detergent companies on their sustainable consumption initiatives
9	Jalapeno August 2014	Phone	UK	Consultant who worked with both detergent industry companies and

				DEFRA
10	Kale April 2015	Phone	UK	Marketing manager, large international detergent company
11	Lemon March 2015	Phone	France	Marketing manager, large international detergent company
12	Mango March 2015	Phone	Netherlands	Corporate Responsibility Manager, A.I.S.E. partner company
13	Neem July 2015	Phone	Belgium	Corporate Responsibility Manager, A.I.S.E. partner company
14	Orange March 2015	Phone	UK	Corporate Responsibility Manager, A.I.S.E. partner company
15	Pear March 2015	Phone	Italy	Corporate Responsibility Manager, A.I.S.E. partner company
16	Quince March 2015	Phone	Belgium	Corporate Responsibility Manager, A.I.S.E. partner company
17	Radish March 2015	Face to face	UK	International Corporate Responsibility manager, A.I.S.E. partner company
18	Saffron March 2015	Phone	France	Corporate Responsibility Manager, A.I.S.E. partner company
19	Thyme March 2015	Phone	Denmark	Corporate Responsibility Manager, A.I.S.E. partner company
20	Ugli May 2015	Phone and email response to questionnaire	Belgium	Corporate Responsibility Manager, A.I.S.E. partner company

21	Vine March 2015	Face to face	UK	Corporate Responsibility Manager, large retailer
22	Wasabi March 2015	Phone	UK	Manager, consultancy working with detergent manufacturers and large retailers on sustainable consumption of clothing
23	Zig Zag March 2015	Phone	UK	Corporate Responsibility Manager, A.I.S.E. partner company
24	Apple August 2015	Phone	UK	Advertising agency account manager, working on large detergent company brands
25	Catnip March 2016	Phone	UK	Retired Corporate Responsibility Manager, large international detergent manufacturer

Appendix Bii

Questionnaire for semi-structured interviews

The use of square brackets identifies minor additions that were used for interviewees when introduction had been made through A.I.S.E.

The Use Chain. I'm interested in initiatives that seek to reduce carbon emissions when consumers use products, [either] from companies done directly [or through an association such as A.I.S.E.,] so I would like to discuss [the 'I Prefer 30' work done recently.

Questionnaire

1. Can you tell me, please, the actual period of time you would say that you were either involved in this work, or this initiative, or heard about it?
2. What do you think the desired impact of it is? ... in terms of targets prompt: specific, measureable, time bound and within a clear boundary in the product lifecycle? in relation to carbon emissions?
3. Can you tell me about the factors that influenced the development of this initiative, as you see them? (Prompt) External? Internal to the association?
4. Some years before this, AISE and the national associations developed Cleanright. What do you know about the Cleanright initiative; what did it aim to do? Prompt, if necessary, from the AISE website copy: The initiative aims at promoting more sustainable use of household laundry detergents. The objective is to focus on energy saving through low temperature washing (which is the biggest area of potential environmental savings) by raising consumer awareness on the benefits of washing at low temperatures.). How would you describe the factors that influenced their development of this initiative? (Prompt) External? Internal?
5. How do you see either of these initiatives in terms of what the companies who are members of AISE or national associations are trying to do? What is the impact of competition on the initiatives, as you see it?
6. How do you see either of these initiatives having related to the public debate about carbon emissions? If at all?

since 1997 (the year of the European Union signing up to the Kyoto protocol to reduce emissions by 8% by 2012 from 1990 levels) (if at all)

since 2007 (the year of the UK Govt Energy White Paper and of the fourth IPCC report?) (if at all) or equivalent for other country

since 2009 (the year of the IPCC meeting in Copenhagen) (if at all) How do you see these having related to any legislation or policy recommendations? (if at all) (Prompt) EU level? Country level?

7. How do you see these as having been influenced by membership of any networks that you, your company (or organisation) participates in? [By

membership of A.I.S.E. or the national associations?] Can you describe these networks to me?

8. What do you think it is about the [IP30] initiative that will get consumers to make a change? *Prompt using 'individual', 'social' and 'material'* (Southerton et al., 2011).
9. I'm going to read out 7 [6] sources of trends that could have influenced the [IP30] campaign initiative and I'd like you to tell me which of them, if any, have influenced it, in your opinion:

They are:

technological product or service innovation

consumers' use of products and other social factors

your competitors' activities [not included for A.I.S.E. interviewees]

retailers' activities

government policies

other political factors

environmental factors

any others I've not mentioned?

10. What do you think your company (or organisation) [or signed up partners] sought to achieve through this initiative?
 - 1) for your consumers? (Or 'for the public') (ie end users for detergent or appliance companies)
 - 2) for your retail customers? (or 'for retailers') (ie retailers for a manufacturing business, this question for branded manufacturers only)
 - 3) for the business(or organisation) itself?
11. How do you think has success been measured for each of these? Have there been any explicitly declared quantified objectives that you can share with me? (or can you broadly describe any that you can't share)
12. How would you describe the motivators and barriers that there were for this initiative? *Prompt using the six core drivers from the Schaltegger et al. (2011) framework.*
13. What have been the outcomes? Any more?
14. How do you relate what has happened for this initiative in relation to carbon emissions?
15. Having done this initiative, what do you think its influence has been on each of the following, if any?:
 - technological product innovation
 - the ways consumers use products and other social factors

government policies or other political factors

environmental factors

your company's (or organisation's) strategy

the way in which the association and the businesses work together

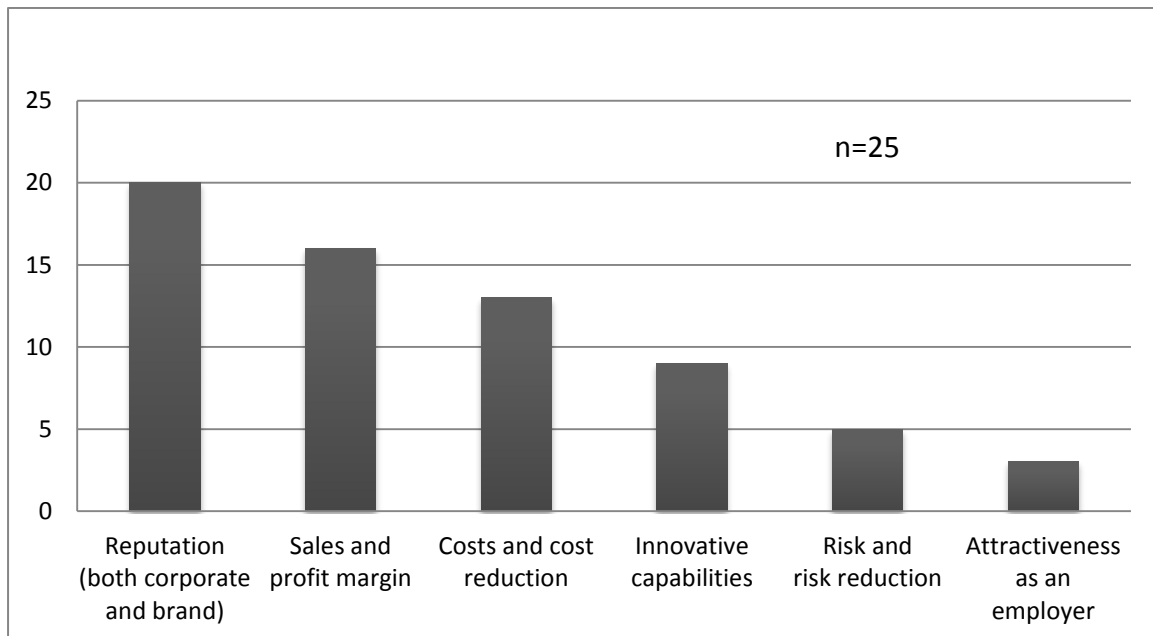
16. What do you expect to happen regarding this initiative in the next two years?

Thank you for your time and responses. Just before we finish, do you think that there is anyone else that I should speak to?

Is there anything else you expected me to ask you, which I haven't covered?

Appendix C

Business case drivers for consumer messages, as assigned by respondents



Appendix D

Number of business respondents stating that the benefit is a consumer motivator

